CALIFORNIA ENERGY COMMISSION

Distributed Generation Strategic Plan

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CALIFORNIA ENERGY COMMISSION
DISTRIBUTED GENERATION STRATEGIC PLAN
TABLE OF CONTENTS

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FOREWORD

This document contains recommended policies and strategies for the State of California to consider regarding the general subject of distributed generation and the State's role in regard to such. Oversight of this report has been performed under the direction of the Energy Commission's Environmental and Energy Infrastructure and Licensing Committee, as agreed upon by the five-member Energy Commission at its December 19, 2001 business meeting. The Committee consists of Commissioner Robert Laurie, presiding member; and Commissioner Robert Pernell, associate member.

This report is not considered the official policy of the Energy Commission or the State of California until it is formally adopted as such.

INTRODUCTION

We are at the threshold of reinventing the electric power system.[1]

The distributed generation industry is at a crossroads. It is rapidly emerging as a major contributor to satisfying the needs of an increasingly sophisticated California electricity market. As the state teetered on the verge of rolling blackouts last year, consumers became more aware of the need for power quality and grid reliability, key features offered by distributed generators. At present, more than 3,000 megawatts of distributed generation facilities are currently operating in California, with an expected 300-400 megawatts in small-scale projects to be added on an annual basis in the near term.[2]

As the number of distributed generation projects grows in California and optimism increases about the potential benefits the industry could provide, so do concerns about the impact that wide-scale deployment might have on the future performance of the California energy system and the environment. Some of the research being done today seeks to answer these questions. However, until these answers are provided, state policymakers must give careful consideration as to whether the rapid promotion of distributed generation is warranted. This Strategic Plan offers the fundamental hypothesis that distributed generation will in fact benefit the grid and energy customers.

This document is designed to articulate the Energy Commission's vision of the future relating to distributed generation, identify issues and opportunities affecting the likelihood of that vision being realized, and address the role that government can play in this process. As it considers the strategy options specific to the goals of the Energy Commission, it will also provide guidance to

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1 Deblasio, Richard D. and Basso, Thomas S. *Status on Developing IEEE Standard P1547 for Distributed Power Resources and Electric Power Systems Interconnection*, March 2002.

2 See California Energy Commission. *Five-Year Investment Plan, 2002 Through 2006 for the Public Interest Energy Research Program*, P.600-01-004b, March 2001.

all state agencies about policies and strategies within their respective jurisdictions that would contribute to realizing that vision.

DG TECHNOLOGY AND MARKET OVERVIEW

All electrons are not created equally.[3]

Distributed generation has been defined in many ways, creating some confusion in terms of regulatory rule applicability. It is most commonly defined as the generation of electricity near the intended place of use. Some parties define it with size limitations, others exclude backup generation, and yet others make no distinction between generation connected to the transmission system or the distribution system. The Energy Commission assumes the following definition,

> *Distributed generation is generation, storage, or demand-side management devices, measures, and/or technologies connected to the distribution level of the transmission and distribution grid, usually located at or near the intended place of use.*

The definition is fundamentally consistent with the CPUC's definition identified in its distributed generation roadmap decision D.99-10-065. The definition has been expanded in this document, reflecting the value of placing distributed generation near the point of use. While distributed generation is inherently related to local transactions vis-à-vis activities that might otherwise be construed to be in interstate commerce, the definition is not designed to preclude the use of distributed generation at the transmission level if the economics of doing so are warranted.

Technology Overview

Distributed generation has many applications and is available using a variety of technologies. Regarding its applications, distributed generation can be used for emergency generation at facilities that cannot afford to have an interruption in electricity service. Such industries include hospitals and high-tech manufacturers. It can also be used to serve peak load needs, with the intent of reducing peak electricity costs to the end-user as well as providing reliability and power quality that the grid may not be able to offer. Finally, distributed generation can be used as a primary source of electricity, essentially reducing or even eliminating reliance on the utility for generation needs. Its use as a primary source is essential in remote locations with no access to traditional power plant generation. The following briefly describes the most prevalent types of technologies commercially available:

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[3] Comment made by Jeff Byron at the Silicon Valley Manufacturing Group Distributed Energy Workshop, March 5, 2002.

Microturbines

Microturbines are small combustion turbines that produce between 25-500 kilowatts of power. Microturbines were derived from turbocharger technologies found in large trucks or the turbines in aircraft auxiliary power units. Most microturbines are single-stage, radial flow devices with high rotating speeds of 90,000-120,000 revolutions per minute. However, a few manufacturers have developed alternative systems with multiple stages and/or lower rotation speeds.

Commercial microturbines produce both heat and electricity on a relatively small scale. The fuel-energy-to-electrical-conversion efficiencies are in the range of 20-30 percent. These efficiencies are attained when using a recuperator (a device that captures waste heat to improve the efficiency of the compressor stage). Cogeneration is an option in many cases as a microturbine is located at the point-of-power utilization. The combined thermal electrical efficiency of microturbines in such cogeneration applications can reach as high as 85 percent depending on the heat process requirements. Unrecuperated microturbines have lower efficiencies at around 15 percent.

Microturbine capital costs range from $700-1,100 per kilowatt. These costs include all hardware, associated manuals, software, and initial training. Adding heat recovery increases the cost by $75-350 per kilowatt. Installation costs vary significantly by location but generally add 30-50 percent to the total installed cost.

Internal Combustion Engines

Conventional combustion turbine generators are a very mature technology. They typically range in size from about 500 kilowatts to 25 megawatts for distributed generation, and up to approximately 250 megawatts for central power generation. They are fueled by natural gas, oil, or some combination of fuels. Modern, single-cycle combustion turbine units typically have efficiencies in the range of 20-45 percent at full load. Efficiency is somewhat lower at less than full load.

Gas turbines are relatively inexpensive compared with other distributed generation options. Combustion turbine capital costs range from $300-1000 per kilowatt and tend to increase with decreasing power output. When compared with reciprocating engines, combustion turbines tend to cost more than the engines, but cost less at the larger sizes. These costs have remained fairly stable in recent history, showing less than a five percent increase over the past three years.

Installation costs, balance-of-plant equipment costs and other miscellaneous costs can be expected to increase first costs by 30-50 percent. Because of their high gas pressure requirements, combustion turbines require natural gas compressors, which is an example of balance-of-plant equipment, unless they happen to be near high-pressure cross-country pipelines. Compressors increase first costs by 5-10 percent. Adding heat recovery capabilities increases the capital cost by $100-200 per kilowatt. Including other balance-of-plant components, the typical installed cost of a mid-sized gas turbine with a heat recovery unit will be in the $1,000-1,200 per kilowatt range.

Stirling Engines

Stirling engines, are classed as external combustion engines. They are sealed systems with an inert working fluid, usually either helium or hydrogen. They are generally found in small sizes (1-25 kilowatts) and are currently being produced in small quantities for specialized applications.

Stirling-cycle engines were patented in 1816 and were commonly used prior to World War I. They were popular because they had a better safety record than steam engines and used air as the working fluid. As steam engines improved and the competing compact Otto cycle engine was invented, stirling engines lost favor. Recent interest in distributed generation and use by the space and marine industries has revived interest in stirling engines and as a result, research and development efforts have increased.

Capital costs of stirling engines ($2,000-50,000 per kilowatt) are generally not competitive with other distributed generation technologies. Stirling engines are currently manufactured in very low quantities which results in the high capital cost. At the high end of the cost range are stirling engines for very specialized (e.g., space) applications. Developers are working to lower first costs through a combination of design refinements and material substitution.

Reciprocating Engines

The reciprocating engine is widely available today. It is the most commonly used technology for distributed generation. The technology is mature, and reciprocating engines are manufactured inexpensively in large quantities. Internal combustion (IC) engine generators for distributed power applications, commonly called gensets, are found universally in sizes from less than 5 kilowatts to over 7 megawatts. Gensets are frequently used as a backup power supply in residential, commercial, and industrial applications. When used in combination with a 1-5 minute uninterruptible power supply, the system is able to supply seamless power during a utility outage. In addition, large IC engine generators may be used as base load, grid support, or peak-shaving devices.

Reciprocating engines can operate on a wide spectrum of fuels including natural gas, diesel, landfill gas, digester gas, etc. Larger engines may last for 20-30 years while smaller engines (< 1 megawatt) tend to have shorter life spans. Reciprocating engines have efficiencies that range from 25-45 percent. In general, diesel engines are more efficient than natural gas engines because they operate at higher compression ratios.

Fuel Cells

There are four fuel cell technologies currently under development: phosphoric acid, molten carbonate, solid oxide, and proton exchange membrane. The technologies are at varying states of development or commercialization (described later in this report. Fuel cells utilize hydrogen and oxygen as the primary reactants; however, they can operate on a variety of fuels depending on the type of fuel process and reformer used.

Natural gas (methane) is considered to be the most readily available and the cleanest fuel (next to hydrogen) for distributed generation applications, so most work is focused on natural-gas-powered fuel cells. However, fuel cells need hydrogen gas to operate and therefore require the conversion of natural gas into a hydrogen-rich gas. In low-temperature fuel cells, this conversion is accomplished using a reformer. High-temperature fuel cells do not require a reformer since the high operating temperature of the fuel cell allows for the direct conversion of natural gas to hydrogen.

Photovoltaic (PV) Cells

Photovoltaic cells convert sunlight directly into electricity. They are assembled into flat plate systems that can be mounted on rooftops or other sunny areas. They generate electricity with no moving parts, operate quietly with no emissions, and require little maintenance. However, the cost is currently too high for bulk power applications.

A photovoltaic cell is composed of several layers of different materials. The top layer is a glass cover or other encapsulant to protect the cell from weather conditions. This is followed by an anti-reflective layer to prevent the cell from reflecting the light away.

Photovoltaic systems are available in the form of small rooftop residential systems (less than 10 kilowatt), medium-sized systems in the range of 10-100 kilowatt, and larger systems above 100 kilowatt connected to utility distribution feeders. The federal government launched a program to encourage the installation of one million roof-top photovoltaic arrays over 10 years.

Wind Turbines

Wind turbines use the wind to produce electrical power. A turbine with fan blades is placed at the top of a tall tower. The tower is tall in order to harness the wind at a greater velocity, free of turbulence caused by interference from obstacles such as trees, hills and buildings. As the turbine rotates in the wind, a generator produces electrical power. A single wind turbine can range in size from a few kilowatts for residential applications to more than five megawatts. A typical life of a wind turbine is 20 years. Maintenance is required at 6-month intervals.

Generally, individual wind turbines are grouped into wind farms containing several turbines. Many wind farms range from a few megawatts to tens of megawatts and have annual capacity factors ranging from 20-40 percent. Wind farms or smaller wind projects may be connected directly to utility distribution systems. The larger wind farms are often connected to sub-transmission lines. The small-scale wind farms and individual units are typically defined as distributed generation. Residential systems (5-15 kilowatts) are available; however they are generally not suitable for urban or small-lot suburban homes due to large space requirements.

The Origins of Distributed Generation in California

Distributed generation existed well before the development of the electric transmission grid. The concept was reintroduced in the 1970s, although the term of "distributed generation" was not coined until the 1990s. Public interest in environmental protection favored the "soft energy path[4]"— a vision of the future in which conservation and renewable energy completely replaced an electric system based on large, nuclear and fossil-fueled power plants. Natural gas was included in this vision as a transition fuel until renewable technologies could take over.

The Public Utilities Regulatory Policy Act (PURPA) of 1978 initiated California's first steps along the "soft energy path." PURPA encouraged ownership of electric generating facilities by independent energy producers rather than by electric utilities. Furthermore, it guaranteed a market for the electricity from PURPA "qualifying facilities" by compelling the utilities to purchase their power under long-term contracts. More than 5,000 MW of renewable energy and gas-fired co-generation facilities were built in California due to PURPA, and federal and state tax benefits for solar electric and wind energy facilities. In the 1980s, the CPUC attempted to acquire new electric supplies from PURPA qualifying facilities but the Federal Energy Regulatory Commission (FERC) halted this process based on utility concerns about the cost.

In the 1990s, California's law to restructure its regulated electric utility industry also created "public purpose" programs, including two administered by the Energy Commission which directly affect distributed generation: the Renewables Program and the Public Interest Energy Research (PIER) program. Both programs provide ratepayer subsidies to developers or users of distributed generation facilities or technologies.

Concurrent with the administrative and legislative proceedings to deregulate electric markets, the Energy Commission helped to form the California Alliance for Distributed Energy Resources (CADER) to address DG equipment manufacturers' concerns about environmental permitting, interconnection rules, and other regulatory and market barriers for their products. The term "distributed generation" was coined at this time.

In December 1998, CADER persuaded the CPUC to open a rulemaking on distributed generation to identify institutional and regulatory barriers to distributed generation. CADER members have also been effective in implementing specific issues in the California Legislature. In recent sessions, new laws were enacted to expanded eligibility for "net metering" programs, provide funds for DG applications, reduce utility rate disincentives, initiate statewide emission standards for the smallest DG units and more uniform permitting rules among air districts.

In the aftermath of California's recent energy crisis, the Legislature created the California Power Authority (CPA) as a financier or owner of electric generating facilities. As part of its work, CPA recently solicited proposals from DG vendors to provide equipment and services for DG projects on publicly-owned buildings throughout the state. The three DG technologies selected for public-facility use by the CPA were: microturbines, including microturbines in combined heat and power applications; fuel cells; and "decentralized" solar photovoltaics. DG programs are now active in a number of State agencies, including the CPUC's self-generation program.

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[4] Lovins, Amory. *Friends of the Earth's Not Man Apart,* Energy Strategy: The Road Not Taken? 1976.

Regulatory Interest in DG

In late 1998, the Energy Commission and the CPUC began a collaborative effort to develop a procedural roadmap for addressing issues related to the distributed generation industry. As part of that effort, standardized interconnection rules have been adopted, incentive programs for self-generation have been initiated, net metering programs have been expanded, and policies surrounding standby rates have been established.

In a related matter, the California Air Resources Board (CARB) recently adopted air emissions standards applicable to distributed generation units, effective January 1, 2003. It should be noted that other state agencies are either conducting distribution generation programs or considering activities involving distributed generation, including the CPA, the California Department of General Services, the State Treasurer's Office, as well as the California Independent System Operator.

The regulatory home for resolving many of these state policies surrounding distributed generation is the CPUC's ongoing distributed generation investigation, R.99-10-025. In particular, that proceeding addressed the following issues:

- developing definitions for distributed generation and DER;
- determining ownership and control of distributed generation;
- developing interconnection standards for distributed generation and DER;
- defining the role of the utilities in distributed generation;
- considering the impacts distributed generation and DER may have on the environment and on distribution system reliability; and
- addressing rate design and cost allocation issues.

The evidentiary record was developed during calendar year 2000, with a reasonable expectation that the CPUC would reach a final decision in the early part of 2001. Unfortunately, the expected timeframe was not attainable due to the need to redirect resources towards the resolution of issues surrounding the energy crisis. As 2002 has arrived along with a better supply/demand outlook for electricity, many of these issues are now being addressed again.

Status of DG in California

Installations

In California, more than 2,000 megawatts can be classified as distributed generation. Emergency backup generation adds another 3,000 megawatts of distributed generation to the total. Most of the generation capacity is technologically grouped as internal combustion based, with individual units often producing in excess of one megawatt. Although the magnitude of generation capacity available is small, the vast majority of physical DG installations throughout the state is renewable-based (photovoltaics) and often associated with utility net metering programs. In formal filings submitted to the CPUC in September 2001, Southern California Edison (Edison) classified more than 500 generating units as distributed generation as did Pacific Gas and Electric (PG&E). San Diego Gas and Electric's (SDG&E) distributed generation inventory includes half of that amount.

Since the approval of new interconnection rules in California, several hundred megawatts of new projects have been proposed. From January 2001 through March 2002, another 129 distributed generation projects was proposed throughout the state, representing more than 400 megawatts of new generation (see Table 1).[5] This estimate does not include hundreds of small-scale renewable distributed generation projects that are eligible for net metering under CPUC rules.[6]

Table 1
Distributed Generation Connects in Investor-Owned Utility Service Territories (Megawatts)

Utility	Operational	Proposed
Edison	724	320
PG&E	1374	53
SDG&E	171	66
Total	2269	439

Sources: 1) California Energy Commission, Utility annual generation filings. 2) DG Interconnection Status Reports, as submitted to the Rule 21 Working Group, March 2002.

Note: Totals do not include generation installed for emergency backup.

<u>DG Enterprises</u>

Like the rest of the California electricity market, distributed generation entities operating in California have had their share of ups and downs during the past three years. During 2000, alternative energy firms raised $2 billion from initial public offerings and venture capitalists, according to the research firm Clean Edge.[7] In April 2001, investment research firms predicted

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5 The figures are based on filings submitted by PG&E, SDG&E, and SCE in their standby rate design applications before the CPUC, Applications 01-09-015, 01-09-016, and 01-09-017, respectively.

6 The numbers in Table 1 include projects proposed under Rule 21. Renewable projects under 10 kilowatts are not treated under CPUC Rule 21 and therefore not included in the total.

7 "Venture Capital Chases the Next Big Thing, and Little Thing, in the Energy Industry, by Justin Pope, *Post-Gazett.com*, July 29, 2001.

that microturbine, fuel cell, and solar photovoltaics companies would grow significantly due to a "vast confluence of political, technological, and social forces that make clean energy a compelling investment strategy."[8] As a result, investors bought stock in publicly-held companies specializing in these areas while investment firms created mutual funds, specializing in energy technology companies.

Issuance of these funds was well-timed to coincide with California's electricity crisis. Some analysts cautioned, however, that some of these investments would be "story stocks" – "unprofitable companies with a great story or concept that has made them Wall Street darlings…[but] not all of these story stocks will have happy endings."[9] Last summer, the value of many distributed generation stocks grew exponentially and then declined after realizing disappointing sales. Today, many distributed generation companies' stock prices remain relatively flat or are in a slow decline.

This remainder of this section focuses on three distributed generation categories having a significant impact on the California market: microturbines, fuel cells and solar photovoltaics.

Microturbine Companies

Microturbine companies are a subset of the turbine generator industry, with California having one of the largest employee bases for turbine developers in the nation.[10] Over the past two decades, the turbine industry has focused on producing gas turbines, combined-cycle, and combined-heat-and-power units. General Electric, Honeywell, ABB, and Westinghouse dominate the turbine industry. Starting in 1998, many of these companies obtained U.S. patents for various microturbine technologies, including Allied Signal, General Electric, Rolls Royce, Honeywell and ABB. Solar Turbines, a subsidiary of Caterpillar, is an example of a California-based turbine manufacturer active in the distributed generation industry. In addition to manufacturing its own products, Solar Turbines has been a major developer and supplier of recuperators for the microturbine industry.

In 1998, Capstone Turbines was the first company to offer commercial power products using microturbine technology, the result of more than 10 years of research and development. Capstone has its headquarters and assembly plant in Chatsworth, California and employs more than 200 people.

CPA's Request for Bids attracted responses from 23 companies interested in doing combined heat and power projects in California public facilities. Microturbine manufacturers participating in one or more of these bids include: Bowman Power Systems (a British company with a North

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8 *Clean Energy Markets: Five Trends to Watch in 2002*, Clean Edge and "Is Energy Technology the Next Big Thing," *Economist.com*, April 19, 2001.

9 "The Power and the Story: Breaking Down the Alternative Energy Plays," by Ian McDonald, *The Street.com*, February 2, 2001.

10 "The New Turbine Industry – Thinking Outside the Grid," Drew Robb, *Energy Tech Online*, July/August 2000.

and South American sales office in Southern California); Capstone Turbine Corporation, DTE Energy Technologies, Inc. (affiliated with Detroit Edison Company); Turbec (a wholly-owned subsidiary of Volvo Aero and ABB); and Ingersoll-Rand Energy Systems.

Honeywell (which merged with Allied Signal) was once a microturbine manufacturer, but it exited the microturbine business in 2001 because it did not see the market developing as quickly as it had originally expected.[11]

Fuel Cell Companies

According to the results of CPA's recent Request for Bids for fuel cell vendors, 14 companies met the minimum requirements and will be invited to compete for future fuel-cell installation projects on public buildings. Vendors representing all four types of fuel cell technologies participated in this solicitation. The Department of General Services analyzed pricing information from the submittals to estimate the average cost of fuel cell energy (installed cost plus operation and maintenance over a 10 year period) This was compared against the current average retail cost of energy at 12-16.5 cents per kilowatt hour today for State facilities located in the service areas of the investor-owned utilities. The DGS analysis suggests:

- **Molten Carbonate Fuel Cell** technology appears to be near cost-competitive now (at 13 cents per kWh in 2003).

- The **Phosphoric Acid Fuel Cell** technology appears close to being cost-competitive, with prices ranging from 16 cents per kWh in 2002, to 14 cents and 12 cents in 2003 and 2004, respectively.

- The **Proton Exchange Membrane** technology bidders did not offer prices competitive with utility commercial tariffs.

- The **Solid Oxide** technology bidders also did not offer pricing competitive with utility commercial tariffs.

A major manufacturer of molten carbonate fuel cells is FuelCell Energy, a Connecticut-based company. In 2000, FuelCell Energy's stock gained more than 440 percent despite annual losses since 1998.[12] Its current manufacturing capacity is 50 megawatts per year and has formed a distribution partnership with Caterpillar, Chevron and CMS Viron.

UTC Fuel Cells, formerly International Fuel Cells, is a unit of United Technologies Corporation. United Technologies Corporation is a $28 billion company, which provides products to the aerospace and building systems industries throughout the world. Its fuel cell subsidiary uses phosphoric acid fuel cell technology developed for the aerospace industry and is one of the

[11] "Microturbines Lose Ground in DG Race," *DG Insight*, December 21, 2001.

[12] "New Power Generation? Fund Firms Bet Alternative Energy Will Be The New Sector Boom," by Ian McDonald, *The Street.com*, January 1, 2001.

largest companies in the world solely devoted to fuel cell technology. ONSI was also a subsidiary of United Technologies Corporation, but International Fuel Cells and ONSI were combined into UTC Fuel Cells.

Solar Photovoltaics Companies

The solar photovoltaics industry has been doing business in California since the early 1980s. Much of the growth in demand for PV products, however, has occurred during the past five years. Strategies Unlimited, a market research firm in Mountain View, California, identified the following companies as leaders in the PV industry: Royal Dutch/Shell Group, Siemens, British Petroleum, Sanyo Electric, Sharp, Kyocera and AstroPower. The solar photovoltaics industry is clearly an international industry.

EPRI reported that 2001 was another "banner" year for photovoltaics. Until 1997, PV module production never exceeded 100 megawatts per year. In 1999, however, producers nationwide made and sold approximately 200 megawatts of modules, and last year nearly doubled that output despite a slowdown in the economy. As such, worldwide PV deployments are well on their way toward a second gigawatt.[13]

AstroPower, Inc. is headquartered in Newark, Delaware and is the world's largest independent manufacturer of solar electric power products. It develops, manufactures, markets and sells crystalline silicon cells, modules, panels and systems for generating solar electric power. AstroPower is part of the Standard & Poors SmallCap 600 and is ranked 39th on Business Week's Top 50 Standard & Poors SmallCap Company list for one- and three-year performance.

AstroPower has attracted a lot of media attention in California because of its success in forming alliances with a number of the state's largest production homebuilders to offer solar electric power as a feature in new home construction. Its partners include Pardee Homes in San Diego, California and Premier Homes in Northern California.

PowerLight Corporation is the nation's leading designer, manufacturer and installer of grid-connected, *commercial-scale* solar electric products and systems. The company was founded in 1991 and remains a privately-owned company. Its manufacturing facility in Berkeley makes the patented PowerGuard PV roof tile assembly for application on flat, commercial roofs. PowerLight's president, Tom Dinwoodie, reported that his company has doubled its revenues every year for the past five years, with revenues now exceeding $25 million annually.[14]

13 Quarterly Status and Technical Progress Report, submitted by Ed Holt & Associates, Inc. to the National Association of Regulatory Utility Commissioners – Photovoltaic Collaboration, April 15, 2002.

14 "San Francisco Bond Issues Would Boost Funding for New Solar Power Capacity," by Jim Carlton, *Wall Street Journal*, November 6, 2001.

VISION, MISSION, AND PRINCIPLES

Distributed generation gives you control.[15]

Vision	**Distributed generation will be an integral part of the California energy system, providing consumers and energy providers with safe, affordable, clean, reliable, and readily accessible energy services.**
Mission	**It is the mission of the Energy Commission to develop programs and policies that will effectively promote and deploy distributed generation technologies to the extent that such benefit energy consumers, the electricity grid, and the environment in California.**

In September 2000, the U.S. Department of Energy (DOE) released its *Strategic Plan for Distributed Energy Resources*, outlining the principal distributed generation objectives of the federal government through the year 2020. In its report, DOE's states the following vision: "The United States will have the cleanest and most efficient and reliable energy system in the world by maximizing the use of affordable distributed energy resources." In support of that vision, DOE intends to lead a national effort to develop "next generation" clean technologies, document the environmental benefits, and implement distributed generation deployment strategies.[16]

The DOE objectives are consistent with many of the activities presently being undertaken in California. For example, much of the R&D projects currently being funded under the Energy Commission's PIER program are designed to increase the efficiency of generating facilities while reducing emissions on a per megawatt output basis. Energy Commission and CPUC efforts towards the standardization of interconnection rules in California, as well as coordinated outreach to entities outside publicly-owned electric utilities has sought to remove this major regulatory barrier to entry.

While similar to DOE's statements in general, the Energy Commission's vision and mission statements are more conservative. Our approach reflects the need to address the technical and market considerations before committing to the long-term vision and goal. If we determine that California energy consumers can benefit with distributed generation, we would be inclined to fully support wide-scale deployment. The goals that surround our mission and vision statements support the need to have the questions answered in the near term (3-5 years).

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15 Comment made by Dennis Roundtree at the Silicon Valley Manufacturing Group Distributed Energy Workshop, March 5, 2002.

16 Source: U.S. DOE, *Strategic Plan for Distributed Energy Resources, September 2000, Page 2.*

The development of this report and its policy recommendations were based on the following principles:

- Deploy distributed generation only in a way that preserves and enhances the environment in which people live.

- Recognize the need for private investment. Without private investment, a self-sufficient distributed generation industry will never develop.

- Provide consumers more choices about how to meet their energy needs, including opportunities to gain more control over energy use and expense.

DEPLOYMENT ISSUES AND OPPORTUNITIES

Distributed Generation has the capacity to rewrite the economic relationship between traditional distribution utilities and their customers.[17]

This section identifies the major barriers hindering the deployment of distributed generation in California and offers a general strategy discussion on key issues. Identification of barriers to deployment has been explored extensively, most notably in a report prepared by the National Renewable Energy Laboratories (NREL) in May 2000.[18] In that report, NREL identifies a series of technical, regulatory, and institutional barriers that have slowed deployment and continue to do so today. Equally important is the development of an action plan that we reproduce in Table 2 and embrace as a general framework for developing our own strategies:

TABLE 2
NREL's Ten Point Action for Reducing Barriers to Distributed Generation

Technical Barriers
- Adopt uniform technical standards for interconnecting distributed power to the grid.
- Adopt testing and certification procedures for interconnection equipment.
- Accelerate development of distributed power control technology and systems.

Business Practice Barriers
- Adopt standard commercial practices for any required utility review of interconnection.
- Establish standard business terms for interconnection agreements.
- Develop tools for utilities to assess the value and impact of distributed power at any point on the grid.

Regulatory Barriers
- Develop new regulatory principles compatible with distributed power choices in competitive and utility markets.
- Adopt regulatory tariffs and utility incentives to fit the new distributed power model.
- Establish expedited dispute resolution processes for distributed generation project proposals.
- Define the conditions necessary for a right to interconnect.

Source: NREL, *Making Connections: Case Studies of Interconnection Barriers and their Impact on Distributed Power Projects*, NREL/SR-200-28053, May 2000, page iv.

[17] Office of Ratepayer Advocates, Comments on Strategic Plan Outline, February 21, 2002.

[18] Alderfer, R. Brent et al. *Making Connections: Case Studies of Interconnection Barriers and their Impact on Distributed Power Projects*, NREL/SR-200-28053, May 2000.

While we fully support the conclusions of the NREL study, one additional important element is needed to complete a strategy assessment as it relates to distributed generation. Strategies surrounding market behavior, consumer education, and cost evaluation tools are imperative to effective deployment of distributed generation and must be included as a critical strategy. Many of these issues are categorized in the sections that follow. Recognizing that the list of issues are not all-inclusive, it is not the intent of this document to address each issue individually. The issues will be discussed as a general strategy, but many of the goals outlined toward the end of the report may seek to respond to a specific issue.[19]

Interconnection Issues

- *Can interconnection rules be standardized throughout California?*
- *Should California support development of national interconnection standards?*
- *Can interconnection be made more user-friendly to the end-use consumer?*
- *Can a substantial amount of DG be interconnected in both radial and networked distribution systems?*
- *Are there safe, reliable and cost-effective interconnection solutions for radial and networked distribution systems?*
- *Can interconnection solutions be deployed in a timely manner?*
- *Can engineering studies for interconnection be eliminated, standardized, or streamlined?*
- *Is a single DG unit compatible with end-use equipment or other DG equipment?*
- *Can qualified interconnection systems be certified so that they may be installed with minimal field testing?*
- *Have potential DG installations been postponed or abandoned due to existing or prior interconnection rules or costs?*

No distributed generation deployment/barrier discussion is complete without addressing issues surrounding interconnection barriers. Distributed generation conferences, regulatory proceedings, articles, and other points of discussion clearly identify the lack of interconnection standards as the primary barrier to entry. This effort is currently being led by the Energy Commission, closely coordinated with the CPUC.

The Energy Commission has overseen the development of standardized interconnection rules in California, culminating in the adoption by the CPUC of rules governing how the investor-owned utilities review and interconnect distributed generation to their systems. A working group led by the Energy Commission continues to meet to resolve ongoing issues related to interconnection. As PG&E mentions in comments submitted in March 2002, Energy Commission efforts have created "a good foundation from which to build policies to lead to more efficient interconnection practices. The root of this effort is the ongoing interconnection workshop process, which is comprised of utility representatives, DG vendors and manufacturers, regulatory representatives, and other interests. These workshops have proven to be a productive forum to openly exchange ideas and develop products that are in the interest of all parties."

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[19] It should be noted that many of the issues were conceived as part of the Energy Commission's PIER Research Assessment work performed last year under the direction of the Energy Systems Integration program. (See www.energy.ca.gov/reports/2002-02-015_600-01-016.pdf.)

PG&E also indicates that it may be useful for publicly-owned utilities to adopt similar rules and suggest that legislation might be pursued to achieve this objective.

Environmental Issues

- *What preferences should be given to "clean" DG technologies?*
- *Should incentives for renewables be further enhanced?*
- *Can air emissions from DG become as clean as that from central station power plants by 2007?*
- *Can air emissions from diesel backup generators become as clean as natural gas-fired generators?*
- *What would be the best way to promote waste-to-energy DG projects that help improve air/water quality and reduce greenhouse gases?*

In California, the California Air Resources Board (CARB) drives air quality policy at the state level although each of the 35 local air districts have great discretion about how those policies are interpreted. In response to legislation signed in 2000, CARB started a process that has produced new regulations restricting the amount of emissions allowed from distributed generation units. The regulations will be effective on January 1, 2003. The driving concept behind the emissions rule was the desire to only deploy distributed generation that meets or exceeds the emissions profile of a state-of-the-art, central station power plant. Under current technological considerations, only fuel cells, photovoltaics, and wind turbines are the only technologies that could qualify.

Beyond the work being performed by CARB, the Energy Commission actively promotes "clean" distributed generation technologies through its renewable energy program. Initiated in 1998, the program has funded more than $25 million in renewable distributed generation and is slated to continue substantial funding through the year 2012.

Debate continues over where the focus of research should go. PG&E notes it may be "preferable to spend research dollars on making these DG technologies competitive in an environmental sense with central station units, and not provide "clean" subsidies to units until they have proven they are really so. ORA suggests that consideration also be given to the value of combined heat and power projects. The Silicon Valley Manufacturing Group also acknowledges the need to promote clean technologies but cautions that long-term economic viability must also be considered.

Grid Effects Issues

- *What are the beneficial/detrimental impacts of high-penetration DG on the T&D system and how may they be quantified and assessed for value?*
- *What are the limits to the level of DG that the grid can absorb without adverse impacts?*
- *What are the limitations on bi-directional power?*
- *Should the design of new distribution feeders consider potential DG that may be added later?*
- *Can the concept of microgrids be made practical? Can they be effectively utilized?*

The Energy Commission and other organizations funding distributed generation research are beginning to look at the impact that wide-scale deployment might have on the traditional grid system. Utilities are concerned that high penetration could be detrimental to the grid by requiring more complex protection schemes. Several research projects in the area are being funded at both the national and the local level. At the national level, DOE and the Energy Commission are major sponsors of the Distributed Utility Integration Test, commonly referred to as DUIT.   This program is looking at the effects of large penetration of distributed generation onto distribution systems.

Microgrids are also emerging as an area of heightened interest in the community of research. Concurrent with the technical evaluation of microgrids is a growing debate between the value that microgrids provide and whether the regulatory framework would support wide-scale microgrid deployment. For example, PG&E in its comments state that microgrids should not be pursued as a matter of policy particularly when rate, reliability, safety and regulatory issues associated with such service has not yet been addressed. The utility argues that it would not be good public policy to encourage the establishment of a number of “mini-utilities without the full charter responsibilities that regulated utilities now have.” ORA, on the other hand, supports the development of microgrids with continued regulatory oversight. It believes that microgrids are the “technological gateway” to wide-scale DG deployment on a plug-and-play basis.

Market Integration and Regulatory Issues

- *How should market rules be modified to allow DG to better participate in current markets?*
- *How may transaction costs associated with interconnecting and permitting be reduced?*
- *Is it in the State’s interest to promote DG?*
- *How can tariffs and rates be designed to provide better price transparency to DG?*
- *Are there too many public subsidies being provided for DG?*
- *Should a separate market structure be created for the full range of DG technologies (i.e., DG aggregation, DG Power Exchange, etc.)?*
- *Should regulatory rules be changed to support the development of microgrids?*
- *Does the suspension of direct access impact the marketability of DG?*
- *Are there ways to balance the imposition of “exit fees” with the marketability of DG?*
- *Can utilities be offered incentives in return for eliminating exit fees when DG is installed on their systems?*
- *Should standards for control/communications be developed to better enable DG to participate in markets?*
- *Should the DG market paradigm shift towards decentralized rather than centralized control?*
- *Should utilities be provided incentives to facilitate DG?*
- *Should utilities be allowed to install and use DG, participate with other DG developers, and if so how should this occur?*
- *Are there market benefits to aggregating DG?*

This area is perhaps the most dynamically debated topic, as market design and regulatory issues evolve at a rapid pace both in California and the rest of the nation. Regulatory review with respect to distributed generation has been led by the CPUC, although the ISO has explored a number of DG policy directions for more than a year. Another aspect not generally addressed but important to note is the review provided by the state’s publicly-owned utilities, whose service territories account for more than 15 percent of electricity consumed in the state.

While policy advances and heightened interest in distributed generation have occurred at the state level, regulatory and institutional barriers surrounding the effective deployment of distributed generation remain prevalent. Major policy decisions have been delayed due to the need to respond to the myriad of energy crisis related activities during calendar years 2000 and 2001. Unfortunately, many of these actions have created new barriers, providing mixed signals to an industry still developing.

Based on discussions with a variety of consumer groups, developers, and financing institutions, it is believed that regulatory uncertainty in California continues to be a major concern for those considering the deployment of distributed generation. Utility rate design is confusing at best, including issues surrounding standby charges, interconnection fees, exit fees, and grid management charges. The timing of legislative mandates regarding rate design and the ultimate implementation of those policies also carry confusion and uncertainty to stakeholders.

The financial fallout surrounding the California energy crisis has created new barriers for the distributed generation community. Among the myriad of energy-related events affecting California during calendar years 2000 and 2001, a key issue impacting the distributed generation market is the recent decision by the CPUC to suspend direct access. Suspension of direct access effectively removes an important benefit from potential users of distributed generation: the ability to sell excess power to retail customers. Without a retail market to supply, a DG user does not have any incentive to oversize a system and sell excess power to retail customers. Ironically, even though options still are available to sell excess power in the wholesale market, wholesale customers no longer have an incentive to do so since excess power is now readily available on the spot market.

From a public policy framework, the inability to resolve the regulatory uncertainties runs counter to the desire to encourage business development in the state. That conclusion impacts all aspects of energy policy. However, clear policy direction with respect to distributed generation policy would at least provide some energy choices to consumers that only have limited energy procurement options.

POTENTIAL ROLE OF GOVERNMENT IN ADDRESSING ISSUES AND OPPORTUNITIES

Government roles with respect to DG can generally be organized into two broad categories: economic development efforts and regulatory activities. A variety of federal, state, and local government entities conduct economic development activities to foster industrial competitiveness, business development, or job creation or to pursue other public policy goals. California-based DG manufacturers and related businesses provide jobs and tax revenues which can benefit the economy. Furthermore, commercial and industrial DG facilities can make these businesses more profitable by reducing their energy costs or by enhancing power quality/reliability within their operations.

Consumer and environmental protection are the primary thrusts of government regulatory activity directly affecting the DG industry. An indirect regulatory activity, however, is the federal requirement to maintain electric grid reliability. The California Independent System Operator has suggested that DG could help it meet its supply-reserve mandates from the Western Systems Coordinating Council.

Consumer protection activities affecting DG deployment include utility regulation and enforcement of building codes and standards. Utility regulation applies to utility business practices, which may discourage consumer choice to install DG equipment. Examples include the legislative mandate that utility rates for consumers with DG be no different than the rates for customers without DG. The California Building Code provides minimum standards to protect public health and safety.

Environmental protection activities seek to mitigate potential negative impacts from equipment installation and operation. Local air districts regulate DG equipment that may cause a negative air quality impact. Other environmental issues are addressed through local government (city or county) planning departments through the land-use permitting process. The California Environmental Quality Act (CEQA) requires preparation of an environmental document only when local zoning ordinances require a land-use permit. Building permitting and building code enforcement are CEQA-exempt processes.

Role of State Agencies

In connecting these concepts to state government, we believe state government could play several key roles in addressing many of the issues described earlier in this report. These roles are grouped into the following categories:

- Plan/Coordinate – State government could conduct specific energy-resource forecasts and needs assessments to determine where regional supply and demand imbalances exist. Forums could be created/continued to discuss distributed generation policy and deployment issues. Activities could also be coordinated among governmental entities to develop strategies, share ideas, and optimize resources.

- Purchase – State government could procure distributed generation for use by government. Orders could be aggregated for distributed generation equipment among governmental entities and arrange for volume discounts from bulk purchases. Government-owned facilities could be utilized to demonstrate the costs/benefits of distributed generation technologies within the community.

- Incent – State government could provide tax, financial or regulatory incentives to encourage deployment of distributed generation or to research and develop technology advances. Additional incentives could be offered to stimulate business entry and growth within California.

- Regulate – State government could impose environmental and consumer protection requirements upon developers of DG projects through the land-use, building, and air quality permitting processes. Testing and certification of DG equipment performance could be required. Utilities could be required to incorporate DG in distribution grid expansions, modify rates and tariffs that do not discourage self-generation. Distributed generation could be recognized within California's Title 24 Building Energy Efficiency Standards.

- Educate/Train – State government could develop informational materials that could increase awareness and interest in DG technology. Analytical tools could be developed to assist consumers in evaluating and purchasing DG equipment/services, and to protect consumers from false performance claims or misrepresentations of government incentive programs. Technical training programs for DG installers and facility operations and maintenance personnel could be developed. Technology transfer activities could be performed to disseminate results from publicly-funded RD&D programs.

- Be Entrepreneurial – State government could provide DG services that are not otherwise provided by the private sector or regulated utilities. This activity might be done to demonstrate the viability of marketing DG products/services within an under-served geographic location or an under-served customer segment.

Numerous California agencies currently conduct DG-related technology development and commercialization activities, including the Energy Commission's PIER and Renewables programs and the CPUC's self-generation program. No statewide programs, however, currently assist DG business development, specifically, although small business assistance programs exist within the Trade and Commerce Agency.

Role of Federal Agencies

At the national level, the U.S. Department of Energy is the foremost federal agency working to promote DG business and technology development. DOE's Distributed Energy Resources

Program implements its *Distributed Energy Resources Strategic Plan*. The program leads a national effort to develop the "next generation" of clean, efficient, reliable, and affordable distributed energy technologies; document the energy, economic, and environmental benefits of the expanded use of distributed energy resources and widely disseminate the findings; and implement deployment strategies, including national and international standards, that address infrastructure, energy delivery, institutional, and regulatory needs

Also within DOE are power-marketing agencies, which sell federal hydropower to publicly-owned utilities and state and federal facilities. In California, the publicly owned utilities buy power from the Western Area Power Administration. As a condition of receiving this low-cost power, federal law requires them to conduct some combination of conservation, co-generation and renewable energy programs under the auspices of their Western- approved “integrated resource plans.”

Role of Local Government

The role of local governments is also critical to future of distributed generation in California. Permitting of DG is most likely to be performed by local governments. As such, local governments will need access to information that will assist them in making these permitting decisions. Some local governments conduct DG-specific economic development activities. For example, the nation’s largest jurisdictions — including San Carlos, San Diego, Long Beach, San Francisco, Santa Monica, Santa Rosa and San Jose — comprise the Urban Consortium Energy Task Force, whose current agenda includes DG building permit streamlining.

Local government facilities offer ideal settings for demonstrating DG technology, because public institutions can tolerate longer payback periods than private businesses and their demonstration sites are visible to local residents and businesses. A number of California cities and counties are now installing DG projects, with assistance from the Local Government Commission and the Energy Commission.

The San Diego Regional Energy Office is taking a comprehensive look at the region’s energy issues and options and developing a regional energy infrastructure plan. The planning scenarios include both moderate and aggressive deployment of DG. Traditionally, utilities and state agencies have conducted energy infrastructure planning, within little or no local government involvement. Local governments, however, have land-use authority that can be used to express preferences toward local, small-scale electric generators for meeting their future energy needs.

Role of Publicly-Owned Utilities

Publicly-owned utilities, classified as either special districts or energy departments within municipal government, also have an important role to play in California’s distributed generation future. They have long recognized the relationship between local economic development and affordable electric service. In fact, energy-intensive industries typically target municipal utilities for plant locations. Publicly-owned utilities use their relatively low-cost electric rates as a competitive advantage to attract new businesses to their service territories. In addition, publicly-owned utilities conduct demand-side management programs (e.g., energy audits and project financing) to retain existing businesses and to enhance customer satisfaction. Some publicly-owned utilities have partnered with industrial customers to build cogeneration facilities, which add new electric supply to the utility's resource mix. They also work with homebuilders to offer solar photovoltaic systems to potential homebuyers.

STRATEGY OPTIONS AND GOALS FOR THE ENERGY COMMISSION

This section represents the heart of the Energy Commission strategic plan, outlining the general strategies and goals for the near-term, mid-term, and long-term. Before undertaking that discussion, a brief review of present DG-related activities at the Energy Commission is warranted. Presently, the Energy Commission conducts distributed generation-related work among three of its technical divisions.

Distributed generation is one of several focus areas of the PIER program, representing approximately 20 percent of all funding since the program's inception in 1998. As of mid-March 2002, 78 projects are identified with distributed generation, spread across the six program areas. Eight of those projects have been completed, with another 61 projects ongoing and nine more planned. Most of the portfolio is focused on reducing environmental impacts and reducing the cost of generating electricity. The most diverse range of projects, however, is found under the Energy Systems Integration (ESI) program area, with projects focusing on interconnection issues, market integration, grid effects, and market structure.

FIGURE 1
PORTFOLIO OF PIER PROJECTS ADDRESSING DISTRIBUTED GENERATION ISSUES

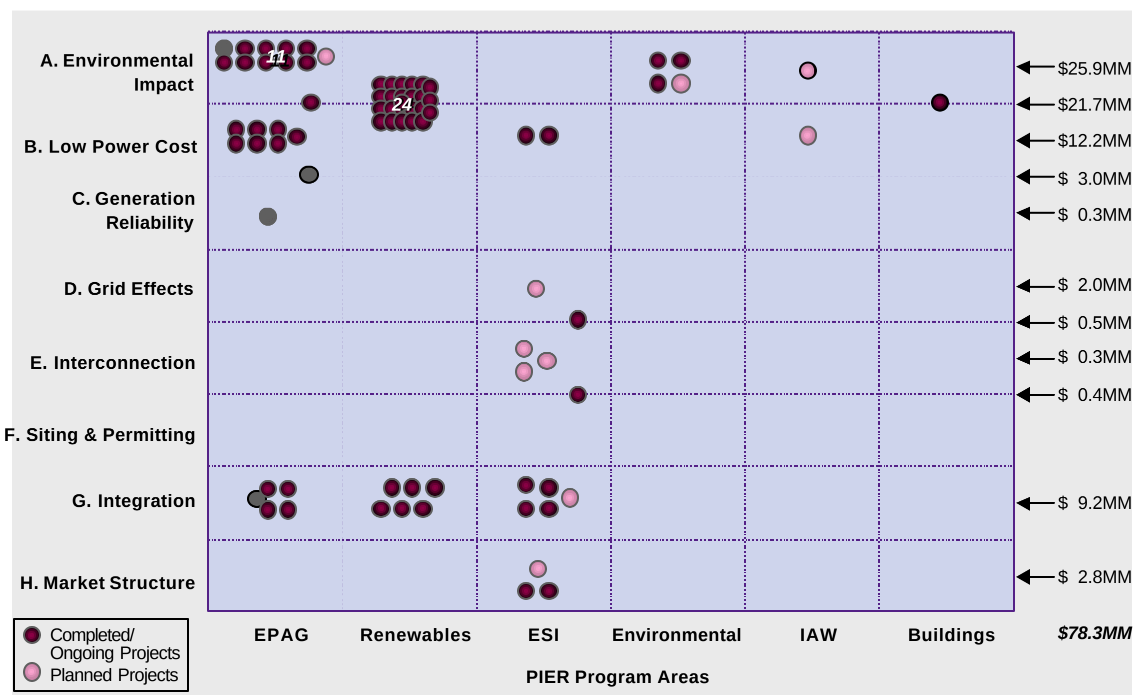

Figure prepared by Arthur D. Little, April 2002.

In total, more than $78 million in distributed generation projects are associated with PIER-related funding. A portion of the funding is related to technology transfer services, most notably technical assistance to the Energy Commission for the development of standardized interconnection rules and the enhancement of the Energy Commission distributed generation website.

The Renewables Program has also provided a significant level of funding to support distributed generation projects. Different from the PIER funding, however, the funding offered under the Renewables Program is for products commercially available today. Since the inception of the program in 1998, the Energy Commission has awarded more than $25 million in renewable distributed generation (photovoltaics, wind, solar thermal energy). Through early 2002, more than 2,000 systems have been installed for California consumers. With the signature of Assembly Bill 995 and Senate Bill 1194 by Governor Davis in September 2000, the program will continue through the year 2012 at the earliest.

Beyond the PIER and Renewables programs, distributed generation activity can be found to a lesser degree in other areas. The Energy Efficiency and Demand Analysis Division performs feasibility studies and provides project financing for public institutions. Energy efficiency projects can include combined heat and power. The Division is also responsible for residential and non-residential energy efficiency standards. Measures can be mandated if found to be cost-effective.

The Energy Commission's PLACES[3] program focuses on local government land-use planning practices and may lead to land-use policies that reduce permitting requirements (and associated environmental review) for DG applications. During power plant siting cases, Commission staff must prepare alternatives analyses for staff assessments. DG technologies are discussed as alternatives.

In summary, virtually all of the funding afforded to distributed generation projects are provided at the research or non-commercial level. While some funding for commercializing technologies are available, the Energy Commission has not placed great emphasis on that element of industry development.

GENERAL STRATEGIES

Any distributed generation strategy endorsed by the Energy Commission must be consistent with the basic tenets established in the Warren-Alquist Act, legislation passed in 1974 which established the Energy Commission. In particular, Section 25400 of the Act states:

> *The Commission shall encourage the balanced use of all sources of energy to meet the state's needs and shall seek to avoid undesirable consequences of reliance on a single source of energy.*

Distributed generation clearly falls within the context of alternative sources, both from a generation and consumer choice framework. Our general framework for developing strategies towards the deployment of distributed generation is based on the following policy objectives:

- **Emphasize End-Use Efficiency Improvements** – *Affect supply and demand concurrently.* Efforts should be directed toward optimizing end-use energy under a "systems" approach, whereby a combination of demand reduction and self-generation options can accommodate the increased demand for electric service. It makes no sense to add on-site generation to power inefficient electrical appliances. At the same time, it may be more acceptable to a facility owner to participate in a utility load-shedding program if the facility can continue operating selected equipment using distributed generation, thereby reducing peak electric demand with no loss in productivity.

- **Promote Resource Planning at Both the State and Local Level** – Electric utilities should explore a wider array of options to meet increasing demand for energy service when performing electric distribution or transmission system planning. Included in this exploration are not only the traditional means (i.e., re-conductoring), but also utility-owned or customer-owned DG generation and storage options. In light of the recent events in California related to the energy crisis, the notion of integrated resource planning has once again emerged as desirable for the state to undertake. DG must be part of that evaluation.

- **Promote Cogeneration** – This is the most efficient DG application overall. System should incorporate thermal in addition to electrical requirements to reduce the amount of wasted energy. That way, electricity becomes a by-product of the heat produced. Also, by displacing space/water heating or process heating, cogeneration offsets one or more fuels. This provides a hedge against rising fuel prices.

- **Diversify Technologies** – Whatever solution is selected to meet future load growth, don't rely too heavily on one particular technology. Over-reliance on one technology or one form of electric generation should be mitigated.

- **Diversify Energy Sources** – While diversifying among different technologies, be aware of the potential risks of concentrating on one or a few fuel sources (e.g., natural gas). Limit fuel source risk by diversifying among technologies that utilize different fuels or can utilize multiple fuels.

Leadership opportunities

The Energy Commission's legislative mandates provides it with authority for taking a leadership role in some of the identified DG policy and program areas. Specifically, the Energy Commission has been tasked with the following DG-related activities:

- Public Interest Energy Research
- Renewables Program

- Building Energy Efficiency Standards
- Power Plant Licensing

Both PIER and the Renewables Program have at least ten years of utility-ratepayer “public goods charge” funding available to conduct technology development and commercialization activities. In addition, these programs allocate portions of this funding for technology transfer and consumer education activities, respectively. Furthermore, the amount of funding available to conduct technology development and commercialization activities is significant relative to other State energy office programs.

The Energy Commission also has two regulatory programs, which could be used to implement a distributed generation policy agenda. The Building Energy Efficiency Standards affect both new construction and major remodels in the residential and commercial building sectors. These standards are updated every three years to reflect advances in the cost-effectiveness of energy efficiency technology. These technologies can either be mandated to be installed in all new construction or they can be recognized as “compliance options.” The Energy Commission has the opportunity to recognize distributed generation’s potential for reducing electric load growth that must now be supplied by the grid.

The Energy Commission’s power plant licensing jurisdiction does not cover distributed generation facilities, but during power plant siting cases, the Energy Commission must evaluate alternatives to the proposed project. Distributed generation is typically discussed in the “alternatives analysis” of Preliminary/Final Staff Assessments. Currently, the methodology used to perform these assessments is narrowly focused on alternative technologies at the project site. In the future, the Energy Commission could develop new methodologies that expand the analysis to the technical and economic feasibility of DG deployment within the surrounding community.

Lastly, the Energy Commission has a number of internal resources which could be used to implement the technical/market analysis and customer education goals identified in this plan. These resources include the following:

- Geographic Information System mapping capability;
- Access to energy use data for use in region-specific supply and demand forecasting and the gas-infrastructure impact analysis;
- Expertise in environmental impact analysis of electric generation facilities; and
- Media and public communications capabilities, including an award-winning Web Site.

Collaboration Opportunities

Other than the above-listed leadership opportunities, the Energy Commission desires to support other State energy agencies, local jurisdictions, electric utilities, or the federal government with distributed generation policies and program initiatives for which they have the lead.

As mentioned earlier, the CPUC and the Energy Commission continue to work together most effectively to develop interconnection standards. Putting these standards into utility tariffs was a major milestone. Now, monitoring implementation of these standards and modifying them when necessary, have become on-going responsibilities.

The interconnection standards were on outcome of the CPUC's distributed generation proceedings. In addition, Energy Commission identified ways to streamline environmental review and permitting of DG facilities. The *CEQA Review and Permit Streamlining Report* submitted to the CPUC in 2000 recommended conducting education services for city and county planning and building department staffs and air districts, but to date none of these recommendations have been initiated. The Energy Commission could partner with the Urban Consortium Energy Task Force, the Local Government Commission, and other local government organizations to bring these services to California jurisdictions.

DG project financing is available from private sources as well as a number of state and federal programs. State programs include the CPUC's self-generation incentive program, the Energy Commission's Renewable Buy-Down program, the State Assistance Fund for Energy, Business and Industrial Development Corporation (small businesses and non-profits only), and the Energy Commission's Energy Conservation Assistance Act (ECAA) loan program (public agencies and non-profits only). A publication has been offered for sale which lists all available government financing programs for DG, but it is not California specific and will be come out-of-date when the CPA sells its first bonds for industrial DG applications. The CPA and Energy Commission are currently working on how to expand ECAA with CPA revenue-bond funds. In the future, the Energy Commission could maintain a database of utility, public and private sources of funds for distributed generation projects and business development, making this information available on its website.

DOE's strategic plan identifies a number of research initiatives to accelerate technology development of distributed generation in the areas of efficiency, reliability, cost-effectiveness, interconnection ease, emission rates, and other necessary improvements. The Energy Commission's PIER program coordinates its research agenda with the DOE program to leverage state funds with DOE funds when possible and to avoid duplication of efforts.

Another area of potential collaboration with the DOE program is technical training for DG equipment installers and operations and maintenance personnel. For example, the California Legislature tasked the Employment Development Department (EDD) to develop training curricula for solar photovoltaic installers, but did not provide any funding for EDD to do this work. The Energy Commission has an interest in helping EDD locate curriculum-development funding. Recently, DOE published information on its work with the Florida Solar Energy Center to develop PV installation curriculum. The possibility of an interagency collaboration could be initiated to help EDD accomplish its training mandate.

Collaboration with private sector organizations should also be pursued. For example, the Energy Commission and the California Manufacturers and Technology Association (CMTA) previously agreed to survey CMTA's members to identify which members are interested in considering DG projects at their facilities. Similarly, the Silicon Valley Manufacturing Group supports end-user surveys, workshops, and outreach meetings to help identify their membership's needs, so that training, and technical and financial assistance programs can be developed to meet those needs.

Lastly, the Energy Commission would like to pursue the idea suggested by the California ISO regarding work on the grid reliability benefits of DG, so that these benefits can be documented and presented to the Western Systems Coordinating Council.

NEAR-TERM GOALS (3-5 YEARS):

It is critical that the Energy Commission perform a comprehensive assessment of technical, and market-based issues before concluding that distributed is a viable alternative or complement to central station power plants, energy efficiency, and load management practices as suggested in the vision statement. The Energy Commission is committed to helping stakeholders better understand DG technologies and the affects that DG applications might have on a utility's distribution system. We offer the following goals for the next 3-5 years.

#1: Develop a Central Repository of Distributed Generation Information

The Energy Commission plays a critical role in providing individuals and companies interested in distributed generation with access to a wide variety of information via its Distributed Energy Resources guide, located on the Energy Commission web page (see www.energy.ca.gov/distgen for more information. The guide provides information on the industry, including technology developments, costs, contact information and links, as well as information on interconnection rule development, and regulatory issues. The focus of the information is on distributed generation in California, with appropriate linkages to web sites highlighting activities in other states and the national level.

The Energy Commission is committed to enhancing the value of the information available to the public with respect to distributed generation. We expect to perform the following activities.

1. Develop a database of all DG installations in California and publish non-confidential information on the website.

Assistance will be needed from city and county building departments and DG equipment manufacturers to compile this inventory. Diesel engines installed for emergency and stand-by generation should be included as well. The database should contain information that would help determine where DG is being installed and what types of technologies are being used. Data would ultimately be published that would help manufacturers determine market share. The data can also be used internally to support demand and supply forecasts.

2. Maintain up-to-date information on distributed generation technologies, including research and evaluation of the following characteristics:

   - Environmental factors, including air quality, noise, water supply, biological impacts

- Efficiency
- Reliability
- Commercial availability
- Installation and operational costs (without direct or indirect incentives)
- Communication/Control/Aggregation

#2: Fund technical research programs that will assist in the development and deployment of distributed generation technologies.

As mentioned earlier in this report, the heart of Energy Commission work addressing distributed generation is its funding of research projects whose results are subsequently disseminated to the public.

1. Conduct research, modeling, and testing to assess how wide scale deployment of distributed generation affects the electricity grid.

The strategic plan's outline raised a number of questions about the effects of interconnecting substantial amounts of DG on the distribution systems, both radial and networked, including safety, reliability and cost concerns. Stakeholder comments supported the need for research in this area. Utility comments noted the importance of field tests to collect actual data. Research in this area will address several questions, including but not limited to the following: How does bulk deployment of DG affect reliability in localized areas? What are the effects of DG on service restoration following an outage?

2. Conduct research that can be used by CARB in its 2005 mid-term review of air quality regulations adopted pursuant to California SB1298 (Statutes of 2000).

The Energy Commission's current research will likely provide some insight about whether distributed generation air emissions regulations will need to be modified. This information is consistent with the desire of CARB to undertake a mid-course review of the regulation in 2005. Energy Commission activities can assist CARB in that endeavor. Can emissions from gas-fired DG technologies become as clean as that from central station power plants by 2007, thereby meeting CARB certification requirements? For DG technologies that require local air permits, are CARB's compliance guidelines for air districts too onerous?

3. Conduct research on "virtual energy networks."

The notion of a virtual energy network has been raised but not fully addressed. Research needs to be performed to understand the potential value that virtual energy networks can provide to the electricity system, beginning with a clear definition of a "virtual energy networks" or "distributed power plants." Research developing communications equipment will be paramount to this effort.

#3: Undertake a series of analyses to determine market, technological, and regional potential for distributed generation in California.

1. <u>Incorporate distributed generation forecast into regular Energy Commission energy forecasting efforts.</u>

Presently, distributed generation forecasts are embedded into the Energy Commission demand forecast, represented as part of the load that is "non-dispatchable" by the utility. As the industry grows, so to does the need to disaggregate this element of the electricity forecasts.

2. <u>Assess microgrids.</u>

Microgrids, like virtual power parks, are drawing increased attention in the distributed generation community. The Energy Commission is committed to investigating microgrids and their potential role in the electricity market. Workshops held at the Energy Commission in May 2002 will begin this process, assessing the technical, economic, and regulatory implications of owner-tenant microgrids?

3. <u>Assess potential impact on natural gas infrastructure from widespread deployment of DG.</u>

The effects of expanding gas facilities to support gas-fired DG technologies and its impacts on natural gas supply and pricing in California should be assessed. Some of the questions needing consideration include but should not be limited to the following: What are the implications of higher levels of DG on natural gas markets? How would the widespread use of gas-fired DG impact the wholesale natural gas market and natural gas distribution infrastructure? In comparison between DG and central station power plant, lower thermal efficiency and higher emissions of DG is noted. If the central station power plants are remote (e.g., Blythe), however, how much of the electricity is lost over the transmission and distribution system before it reaches the point of use? How does this plant's total costs, including line losses, compare to the total costs of a DG unit located near the point of use?

4. <u>Assess utility distribution system design philosophy.</u>

How can design tools be modified to accommodate the growing demand for DG so that interconnection can be streamlined and so that DG can become an integral part of the utility distribution system, where appropriate?

#4: Identify and describe institutional and regulatory issues that interfere with purchasing, installation, and operation of distributed generation facilities.

1. <u>Assess economic feasibility of third-party financing and third-party ownership of DG with current level of government and utility subsidies.</u>

In the 1980s, a number of qualifying facilities and solar water heating projects were financed using limited partnerships. These limited partnerships either leased the DG equipment to the host facility or they contracted to provide energy services to the host facility. The limited partnerships, as owners of the DG equipment, retained the federal and state tax benefits, while the host facilities received use of the DG equipment with no up-front costs.

Both the federal and California state governments encouraged use of these financing arrangements by publishing reports, which described alternative financial arrangements (e.g., lease versus energy service contracting), the available government tax incentives, and the criteria for incentive eligibility. Lessons learned in the 1980s on how to use limited partnerships to finance DG might be useful today, because of new federal and state tax incentive programs and new utility-ratepayer subsidies. This activity calls for a report to be published explaining how this type of financing is done.

2. <u>Participate in policy debate regarding utility tariffs, demand charges, standby charges and exit fees for DG users.</u>

Addressing financial issues surrounding the resolution of the California energy crisis has raised major policy issues regarding whether utility tariffs and, most notably, whether exit fees and grid management charges will be assessed to self-generation customers. Proponents of distributed generation argue that the imposition of these fees on a "departing load" customer using distributed generation will make many of these projects uneconomic. As such, deployment of distributed generation is severely hampered.

On the other hand, parties argue that all consumers should be financially responsible for repayment of energy-crisis related costs. As the debate on these issues proceed, it is important to investigate approaches that balance the need to recover energy crisis costs and the ability to effectively deploy distributed generation. The Energy Commission believes that a comparison of California tariffs and other utility charges with other states deploying distributed generation is necessary, in order to determine the potential impact that certain rate design policies might have on DG project cost-effectiveness. Recognizing that many of these issues have been addressed by the CPUC in its distributed generation proceeding, additional analyses should not overlap with that work as these results can be incorporated into the DG activities of publicly-owned utilities.

3. <u>Expand net metering programs to other types of DG.</u>

Address issues raised by Cal-ISO regarding the relationship between DG, grid reliability and Western Systems Coordinating Council (WSCC) and North American Electric Reliability Council (NERC) minimum operating reliability criteria (MORC). Provide proof to WSCC of DG's grid reliability benefits. Cal-ISO requirement for gross metering of generation and load, and use of gross metering data as the billing determinant for ancillary service charges, grid management charges, and transmission access charges. "Harmonization" of state and federal requirements: potential to use of gross metering data used for purposes of retail requirements and settling retail charges as well.

4. Support and monitor programs designed to aggregated DG loads.

With the suspension of direct access in California, a viable approach to improve the economics of a distributed generation project has been removed from the evaluation of a self-generation project. Similar to a pilot project created by the California Independent System Operator, the Energy Commission supports aggregated programs that provide self-generation customers with a wider array of options for utilizing the technology. In March 2002, the ISO initiated a pilot aggregation program that sought to schedule up to 10 megawatts of distributed generation along the ISO grid. While the ultimate success of that program has yet to be determined, the Energy Commission believes in the concept. As such, we envision working with the ISO or other entities to develop similar programs to determine whether load aggregation is viable for self-generation customers with excess power available for sale.

#5: Create regulations designed to minimize conflicts between utilities and DG developers.

1. Continue to develop and implement interconnection rules.

The Energy Commission remains committed to the development of standardized interconnection rules across California. As part of that effort, we will continue to oversee the Rule 21 working group and monitor utility implementation of interconnection standards. We will also investigate: a) whether potential DG installations have been postponed or abandoned due to existing or prior interconnection rules or costs; b) approaches for eliminating, standardizing or streamlining the work associated with conducting engineering studies of interconnection; 3) enhancing the distributed generation equipment certification program; 4) creating documents and tools that will explain the interconnection process; and 5) educate city and county building departments about the interconnection process, so that they can help with the consumer education process.

2. Support publicly owned utilities' adoption of Rule 21 interconnection standards.

Since publicly-owned utilities serve approximately 15 percent of the state's electricity consumers, statewide interconnection rules cannot truly be standardized without a wholesale approval of Rule 21. The Energy Commission has performed outreach services to the public-owned utilities with the intent of assisting with using consistent interconnection rules and recognizing the jurisdictional differences between their constituency and CPUC rules. To date, the City of Riverside expects to be the first non-CPUC entity to adopt a similar rule, with other utilities giving serious consideration to doing the same.

3. Support IEEE certification efforts.

Since Rule 21 relies heavily on interconnection standards being developed by IEEE, the Energy Commission should take steps to ensure that Rule 21 is modified to accommodate modifications to IEEE standards at the national level. At present, the Energy Commission retains individuals actively involved in the IEEE P547 process, including those involved in the direct write-up of the standard.

4. Develop DG design standards and permit standards.

Consult DG vendors and city and county governments to determine whether potential DG installations have been postponed or abandoned due to CEQA process, land use permitting rules or land use permit costs. Have potential DG installations been postponed or abandoned due to local government building permit process, building code interpretation, or building permit costs? Develop information materials and conduct training to streamline the permitting processes.

5. Recommend legislation that support the policies and strategies included in the approved Strategic Plan.

Provide technical and policy analyses to the Energy Commission's Office of Governmental Affairs regarding proposed DG legislation.

#6: Provide incentives that encourage the deployment of distributed generation, with additional incentives afforded to "environmentally preferred" technologies.

1. Inventory all state and federal subsidies for DG technologies.

Some parties have expressed concerns that DG is over-subsidized and suggest that the state should analyze how to best utilize incentives as it relates to distributed generation. Some of the questions to address in such an analysis include the following: Are additional subsidies warranted? If so, for what purpose and for how long? What is the appropriate role of government in encouraging and/or subsidizing certain DG technologies versus other available means of balancing supply and demand and ensuring reliability of the transmission and distribution systems if the state? Evaluate the transfer effects of any policies designed to subsidize DG located at customer sites. Are residential customers subsidizing commercial/industrial customers? Are low-income residential customers subsidizing wealthy residential customers?

#7: Establish a DG State Agency Coordination Group to cooperatively address distributed generation issues and ensure consistent handling of these issues throughout state government.

A variety of state agencies currently undertake some kind of distributed generation program activity. However, with the exception of the interconnection work and incentive programs developed under a close collaboration between the Energy Commission and the CPUC, coordination is virtually non-existent. The desire to create a statewide agency coordination group is desirable to better coordinate activities and is consistent with Section 25224 of the Warren-Alquist Act:

> *The Commission and the other state agencies shall, to the fullest extent possible, exchange records, reports, material, and other information related to energy resources and conservation and power facilities siting, or any areas of mutual concerns, to the end that unnecessary duplication of effort may be avoided.*

The Energy Commission will solicit interest in a DG State Agency Coordination Group with its sister agencies during the third quarter of calendar year 2002, with the intent on meeting on a quarterly basis. The principal objective of the group will be to ensure that governmental program development is coordinated across all state agencies and program overlap is minimized if not eliminated entirely.

#8: Raise consumer awareness about distributed generation.

1. Develop targeted consumer education campaigns.

Utilities have suggested that an education program is needed for consumers to protect them from unfair or abusive marketing practices. Others suggest the need for targeted consumer education programs for the building industry (e.g., homebuilders) and for public agencies (e.g., potential adopters of DG technology). A permit streamlining program would include targeted training programs for city and county planning and building department staffs and air district permit staff.

2. Support the activities of CADER

CADER consists of representatives from all aspects of distributed energy resources, such as, all technologies providing distributed generation, regulatory and policy bodies, special interest groups and governmental communities. In its non-advocacy role, it is considered a neutral source of information related to the industry.

The Energy Commission anticipates that CADER will continue in its mission to facilitate deployment of clean and economic options of using distributed energy resources. The Energy Commission also anticipates that CADER step up its efforts in educating market participants and federal, state and local governmental communities in assessing and analyzing the market potential for distributed generation. In order for DG to succeed in providing clean and efficient local power, a coordinated effort is necessary from a total systems approach perspective rather than the success of a single particular technology or application.

CADER should seek and secure appropriate funding to accomplish this essential task to build a strong foundation to assist decision-makers and facilitate a smooth and beneficial implementation of distributed energy resources.

MID-TERM GOALS (5-10 YEARS):

#1: ***Reduce distributed generation equipment costs to a level that would obviate the need to provide government incentives to deploy distributed generation.***

#2: ***Enhance the emissions and efficiency profiles of distributed generation technologies such that the economics and permitting support wide-scale deployment.***

#3: ***Establish markets that pay for the full value of DG, including grid benefits, environmental benefits, greenhouse gas reduction credits, energy conservation, and waste reduction benefits.***

#4: ***Certify and deploy DG systems in such a way that procuring distributed generation is as routine as purchasing appliances for the home.***

LONG-TERM GOALS (BEYOND 10 YEARS):

#1: ***Make California's energy generation and delivery system the cleanest, most efficient, reliable, and affordable in the nation by maximizing appropriate use of distributed generation.***

#2: ***By 2020, 20 percent of all incremental generation will be DG.***

GUIDANCE TO OTHER STATE AGENCIES

The Energy Commission recognizes that realizing the full intent of this Strategic Plan will not be possible without the close coordination and mutual cooperation of our sister agencies across the state. With resources limited, the synergies of working on a common direction represents good public policy and provides an opportunity for the state to spend its taxpayer dollars most effectively. The synergies of developing a well-coordinated program are paramount to the success of this plan.

As a starting point, we stress the importance of actively participating in a state agency distributed generation working group. Agencies we anticipate being part of the group include but are not limited to the following:

California Air Resources Board
California Public Utilities Commission
California Consumer Power and Financial Authority
Department of General Services
Employment Development Department

Since we do not have statutory authority to require participation by other agencies, it is critical that each agency participate willingly and should do so to the extent that their involvement will improve related distributed generation activities in California.